Device intervention in the pediatric catheterization lab
by Susan Foerster, MD

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The last two decades have resulted in vast advances in the field of cardiac intervention, particularly with regard to nonsurgical closure of holes and shunts. Almost all device closure procedures involve less pain, give a better cosmetic result and result in less time in the hospital than with surgical closure. However, the degree of efficacy and risk also needs to be close to or better than those achieved with open techniques to gain wide acceptance. The cost often is similar between the two groups. Long-term data is needed to ultimately determine the better course of action, and this data still is being accrued.

The most common device intervention has been closure of the nonneonatal patent ductus arteriosus (PDA). Most neonatal ducts are treated medically first and then surgically if there are symptoms deemed related to the duct, particularly in the premature infant. Beyond the neonatal period, most ducts are associated with no clinical symptoms and do not respond to medical attempts at closure. They often present as a heart murmur or are found when imaging is performed for another indication. Rarely, patients have congestive heart failure symptoms, such as poor weight gain, frequent lung infections or failure to thrive. If there is dilation of the left heart on ultrasound, reflecting a sizable increase in pulmonary blood flow, almost all cardiologists will recommend device closure. This can be accomplished easily in patients weighing more than 5 kg in most circumstances, although it is somewhat easier in the larger toddler.

There is much more controversy about the need to close small ducts, particularly when they are not audible. While the argument for closure used to be based on the need for subacute...
bacterial endocarditis (SBE) prophylaxis, this no longer is recommended based on the most recent American Heart Association guidelines. SBE in an isolated small ductus almost never occurs. The decision on whether to proceed often is based on the preference of the referring cardiologist given the very low risk of complications with device closure. Removing a disease label also is a consideration for future insurance concerns.

At this time, there are two broadly used options for ductal device closure. The first method involves placement of one or more vascular coils and is used for the smallest ducts (diameter less than 1.5 mm). Given the greater difficulty with implantation, as well as a higher risk of embolization or a residual shunt with larger ducts, most interventionalists prefer to use a preformed ductal device for larger vessels, usually an AMPLATZER® Ductal Occluder. (See Figure 1.) These come in a variety of sizes and generally are very easy to use, with excellent results. In very small children, it is important to ensure no obstruction to the left pulmonary artery or descending aorta after placement.

Another common indication for an occlusion device is for closure of atrial septal defects (ASD). In childhood, ASDs often are asymptomatic, with a soft pulmonary outflow murmur or a widely split S2. Patients with larger defects can have increased pulmonary blood flow and an increased chance of respiratory symptoms and frequent infections. Older patients with hemodynamically significant defects have higher rates of symptomatic heart failure, pulmonary hypertension and atrial arrhythmias if the defects are not closed by early adulthood.

At Children's Hospital of Wisconsin, we generally look for echocardiographic evidence of dilation of right heart structures when we recommend closure. To qualify for nonsurgical closure, defects must have sufficient atrial septal margins to hold the device without interfering with the atroventricular valves or systemic/pulmonary veins. Endocardial cushion (primum) defects and sinus venosus defects are not suitable. The AMPLATZER® Septal Occluder (See Figure 2.) is by far the most commonly used in the U.S. and worldwide, largely relating to its ease of delivery, relatively small sheath size for implantation and retrievability should repositioning be required.

Ultrasound guidance generally is used in addition to fluoroscopy to assist in assessing the candidacy of each defect for device closure. As with any procedure, there can be rare complications with use of this device, including erosion of the device into the aorta in about 1 in 1,000-5,000 patients and acquisition of EKG changes or even heart block in a small group. This usually is with oversized devices or those used to close relatively large defects and can be diminished through patient selection. The HELEX® device (W.L. Gore & Associates, Inc., Flagstaff, Ariz.) is another common alternative for smaller defects and is less prone to the above issues, although it is more challenging to place and requires a larger sheath.
Other mainstream devices have been developed to occlude various types of collateral vessels or other vascular anomalies and, less commonly, for closure of muscular ventricular septal defects (VSDs), especially when in a hard-to-reach area. Currently, devices are in development to close VSDs near the aortic valve (perimembranous) as well as a modification of the PDA device that may allow for its use in the neonate. Neither of these applications is “ready for prime time,” and they will have to be very good given the relative low risk of surgical interventions in these two areas.

References

Heart Matters
Children’s Hospital of Wisconsin’s Herma Heart Center is one of the nation’s top programs for medical and surgical treatment of congenital heart defects and heart disease in children. As one of the largest pediatric cardiac programs in the United States, we have set national benchmarks for surgical outcomes.